Managers from Global Security and Weapons delve into criticality safety training

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The class highlighted the physics of criticality using tangible demonstrations with real material

A cross-section of managers participated in a hands-on Criticality Safety Class recently held at the National Criticality Experiments Research Center (NCERC) located on the Nevada National Security Site (NNSS). The class, jointly organized by the Global Security and Weapons directorates, highlighted the physics of criticality using tangible demonstrations with real material. The three-day training included a tour of the NNSS complex and two intense days of classroom and laboratory instruction that provided an introduction to criticality safety fundamentals and hands-on experience building a critical system. The two-day classroom course included criticality safety fundamentals, an introduction to critical experiments and experimental methodology, a review of process and experimental criticality accidents and hands-on nuclear material and critical assembly demonstrations. “The objective of the training is to provide the Laboratory’s future leaders with solid working knowledge of nuclear criticality safety and material operations,” said Evelyn Mullen, Chief Operations Officer for Global Security. “Managers who attend this training gain a better understanding of nuclear experiments and an appreciation for the complexities of the NCERC facility and team of experts who support key mission areas of Global Security and the Laboratory at large.”

On arriving at the NNSS complex, participants spent part of the first day touring the complex and visiting a few historic sites. Stops throughout the morning included Frenchman Flat, the site of the first nuclear test in NV, and the Tumbleweed Test Range. The group then headed to the Device Assembly Facility (DAF) and toured NCERC, home to the nation’s only general-purpose critical experiments facility and staffed with some of the most highly specialized individuals on Earth. NCERC is funded by the Nuclear Criticality Safety Program (NA-511), and its mission is to conduct experiments and training with critical assemblies and fissionable material, at or near the critical state, in order to explore reactivity phenomena. This focus is aimed at ensuring the safety and security of operations involving nuclear materials throughout the United States and the world. The first day ended with a windshield tour of ICECAP-B, a modular tower built for a nuclear test that never occurred due to the Underground

Nuclear Testing Moratorium, the Big Explosives Experimental Facility (BEEF), a hydrodynamic testing facility, and a stop at the Sedan Crater.

On day two the managers moved into the classroom and learned criticality safety fundamentals including radiation safety vs nuclear criticality safety, neutron interactions, critical mass and volume and safety margins. They also were introduced to the four critical assembly machines still in operation today. Planet, a general purpose, light-duty vertical lift assembly machine, Comet, a general purpose, heavy-duty vertical lift machine, Flattop, a fast benchmark critical assembly machine, and Godiva IV, a fast burst reactor were all developed at LANL. Managers were taught about Planet's operations including experiment methodology, hand-stacking and remote approach to critical operations. Before any operation with fissile material begins throughout the DOE complex, the entire process must be determined, with extremely high fidelity, to be subcritical, under both normal and credible abnormal process conditions. In contrast, the experiments at NCERC intentionally take fissile material to and above the critical state but only under an extremely well controlled environment. These experiments provide required data that allows operations with fissionable material to proceed throughout the DOE complex. "The Planet, hand-stacking experiment was the most compelling in my opinion," said Michael Cai, ISR Deputy Division Leader. "Learning the science and technology behind these unique and very intricate experiments was key. The high degree of complexity and preparation that precedes a nuclear experiment can be fully understood only through participation. I highly recommend this valuable training."

On the third and final day participants learned about Flat-Top operations and participated in a hands-on demonstration of the BeRP Ball and Np Sphere, both essential components in nuclear experimentation. The day ended observing a Godiva IV burst operation (demonstrating the effects of a criticality accident) and touring a Fissionable Material Staging Vault. On both days of instruction, students learned about and discussed historical criticality accidents here in the United States and abroad. They analyzed what went wrong and how lessons-learned from those incidents have influenced how operations are performed today. David Hayes, NEN-2 Advanced Nuclear Technology Group Leader and NCERC instructor, helps develop and teach the curriculum. "I believe hands-on experience building a critical system is invaluable," said David Hayes. "There is no better learning opportunity than when students are able to execute the experiments themselves. Participating in these experiments enables them to witness how small changes with fissile materials have serious safety implications."

Participants for the April class included Global Security and Weapons managers responsible for operations or operational oversight involving special nuclear materials. Attendees were chosen through a nomination process and then each submitted a write-up on the value the training would bring to their line of work. To learn more about criticality safety class offerings, contact David Hayes.

Caption for image below: *Mary Hockaday stacks polyethylene plates and uranium foils during a hands-on experiment used to demonstrate the effects of moderators and reflectors on fissile material operations.*